

A Brief History of Clean Coal Gasification Technology— From Cool Water to FutureGen

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Coal Generated Electricity in CA:

Currently 4744 MW Imported

<u>Plant</u>	<u>Total MW</u>	<u>Coal</u>	<u>Owner</u>	<u>% CA</u>	<u>CA MW</u>
Navajo	2409	Bit	LADWP	21.2	510
Reid-Gar.	612	Bit	DWR	67.8	183
Mohave	3272	Bit	LADWP/SCE	38	1244
Four Corners	2070	Sub	SCE	48	786
San Juan	1848	Sub	Munis	24.2	447
Intermt.	1640	Bit	Intermt.	96	1574

Can IGCC Compete with PC Boilers for the Coal-Fired Generation Market?

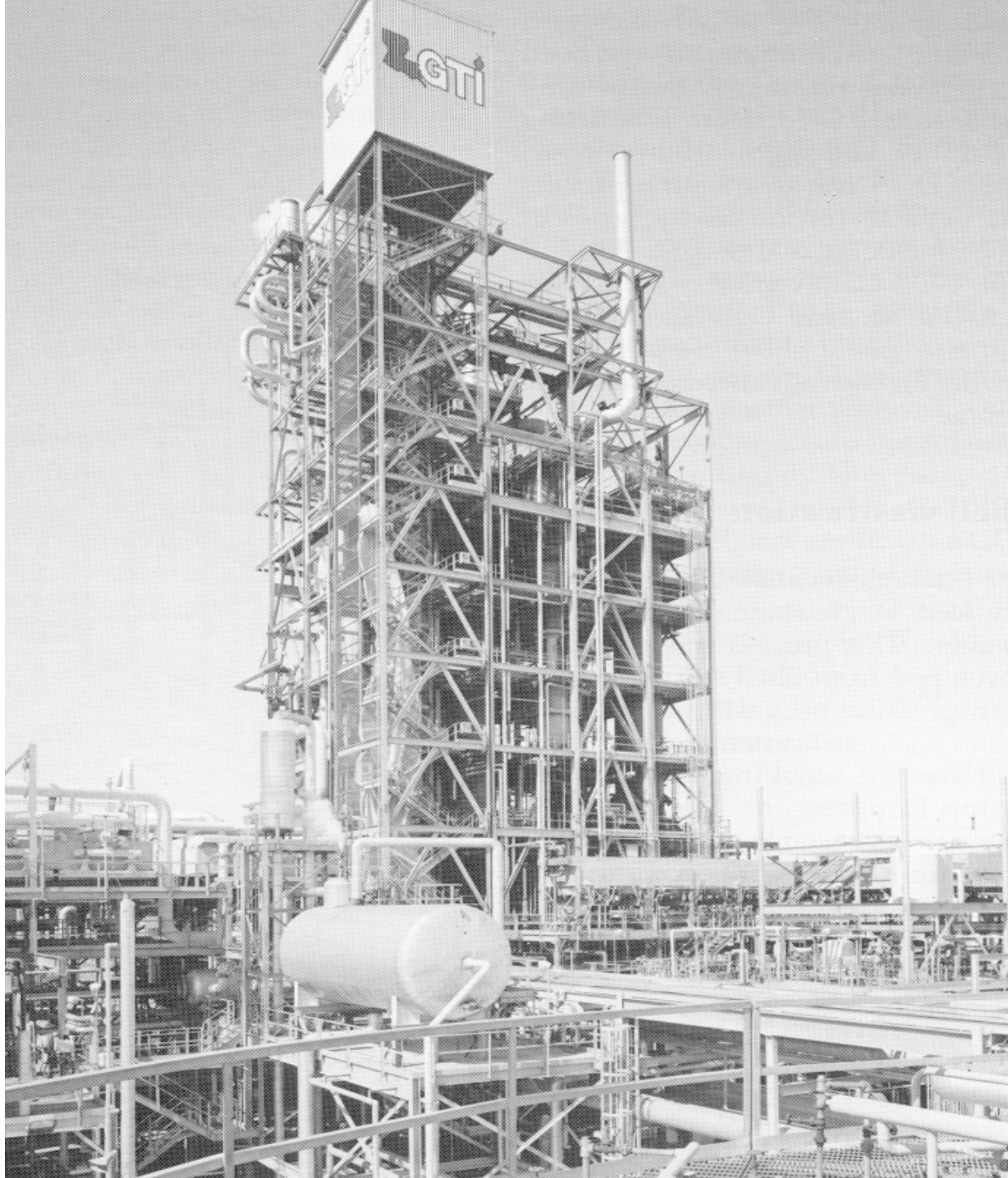
- **Plusses**
 - Higher efficiency
 - Lower emissions of priority pollutants
 - Less costly power if 90% CO₂ capture is required
 - Simple transition to hydrogen production for integration with fuel cells, fuel cell gas turbine hybrids
- **Minuses**
 - Current capital cost
 - Current reliability
 - Experience level of power industry
 - Plusses are stronger for high sulfur bituminous coals; significantly reduced or eliminated for low rank coals

Cool Water IGCC Plant Daggett, CA



Cool Water Gasification Project, Daggett, LA (SCE site)

- **Operating Period 1984-1989**
- **GE (formerly Texaco, ChevronTexaco) technology**
- **1150 TPD southern Utah (SUFCO) coal; 100 MW**
- **Product gas fueled GE 7E combined cycle**
- **Basis for Tampa Electric Polk Power Station**
- **Financial support from Synthetic Fuels Corporation**



**LGTI
Gasification
Plant
Plaquemine,
LA**

LGTI Gasification Project, Plaquemine, LA (Dow Chemical Plant)

- **Operating Period 1987-1993**
- **E-Gas (formerly Dow, Dynergy) technology**
- **2400 TPD Powder River Basin Coal; 160 MW**
- **Product gas refueled two Westinghouse modified W501D5 gas turbines. Gas turbine fuel was 80% syngas and 20% natural gas**
- **Basis for Wabash River Generating Station**
- **Financial support from Synthetic Fuels Corporation**

Shell 250-400 T/D Pilot Plant Experience

- **Operational during 1987-1991 at Deer Park, TX**
- **Tested 18 feedstocks including Powder River Basin Coal, Texas lignite, and Southern Utah (SUFCO) coal**
- **Information was used to design 250 MW Buggenum unit**

Today's - Existing Coal-Based IGCCs



Puertollano (Spain)



Wabash (Indiana)



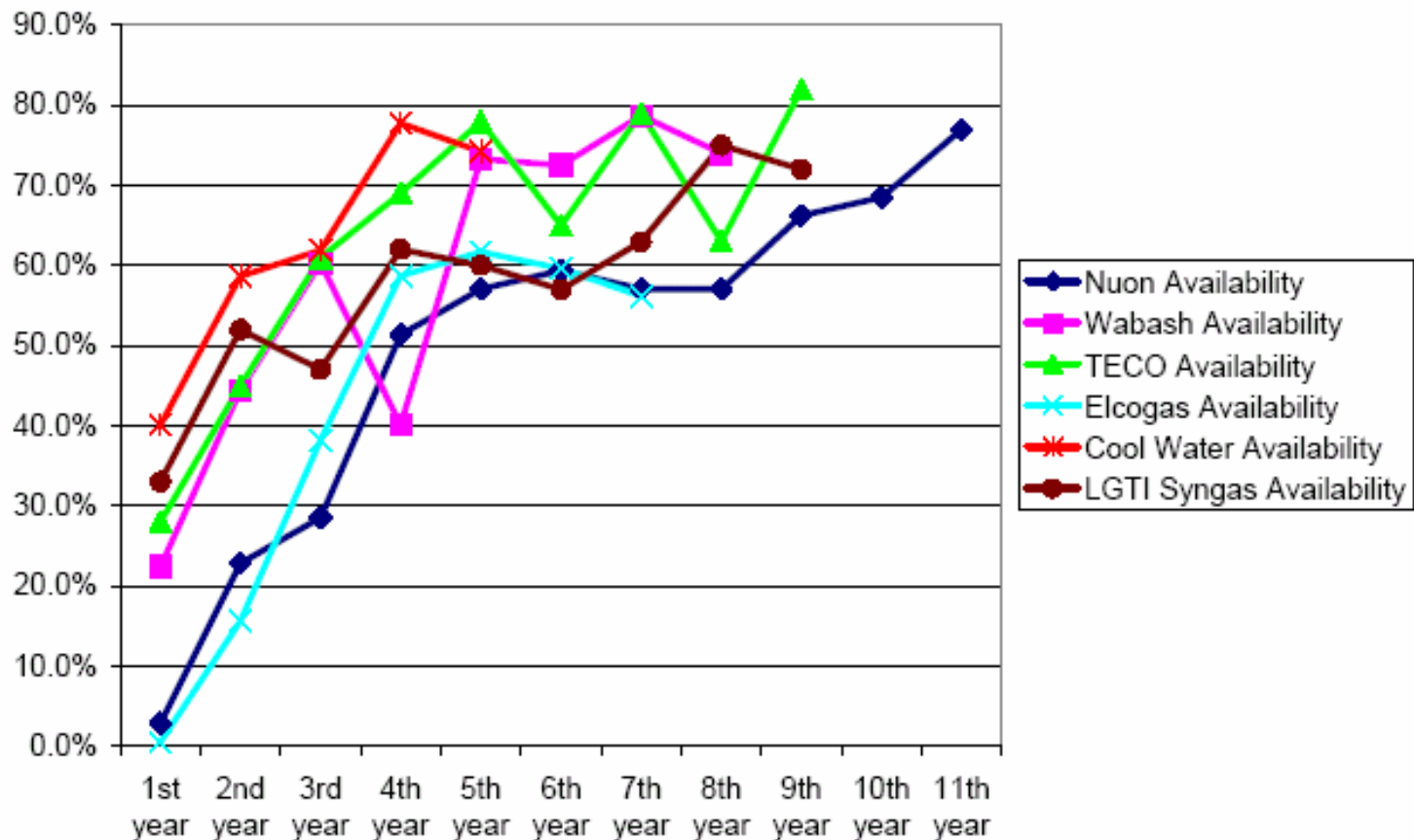
Polk (Florida)



Buggenum (Netherlands)

IGCC Availability History

(excludes operation on back-up fuel)



Reference: Jeff Phillips, EPRI

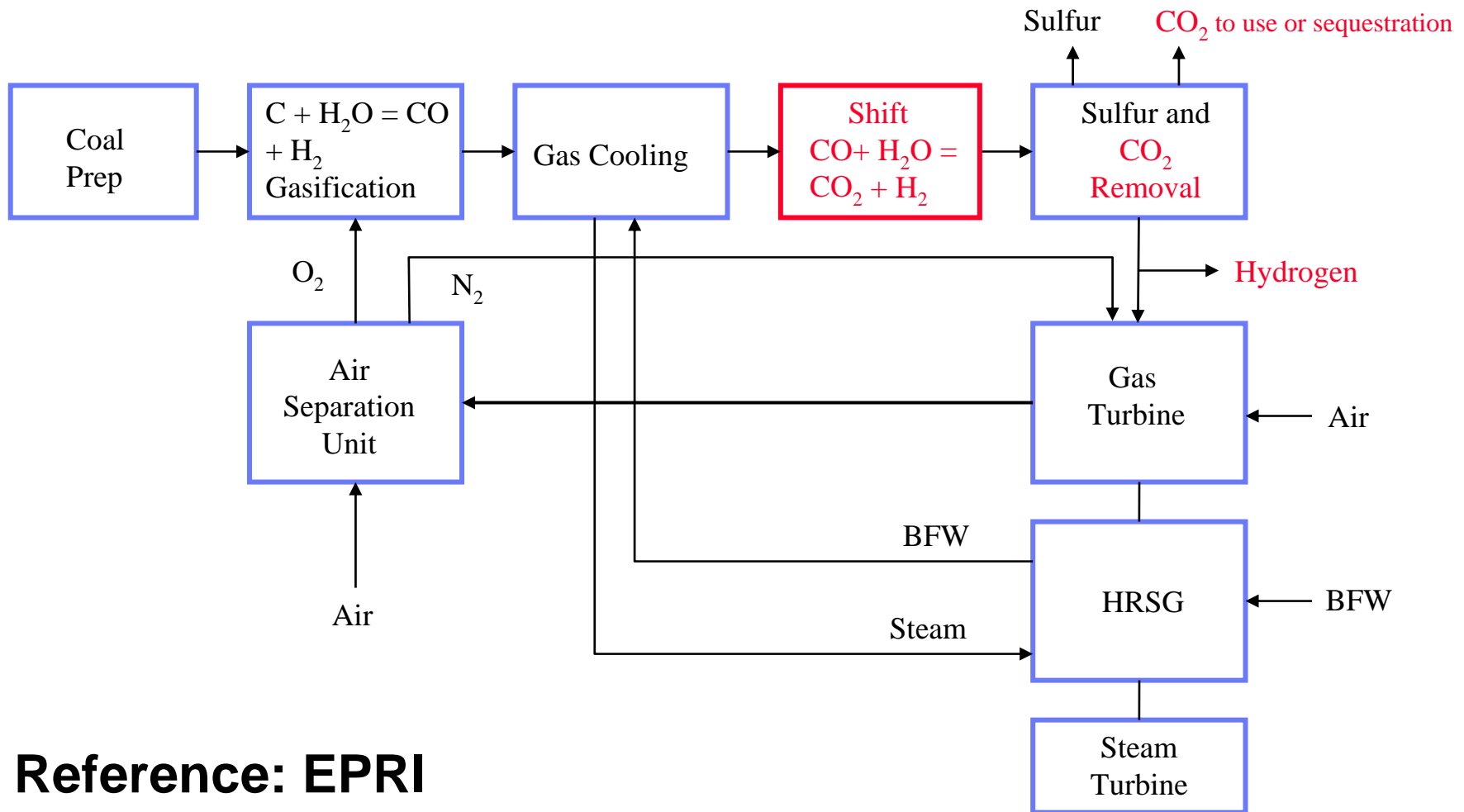
Air-Blown IGCC Plant for Powder River Basin Coal

- **DOE selected an air-blown, Transport Reactor, Powder River Basin coal fueled, 280 MW IGCC plant project to be built at Orlando, FL in response to the Clean Coal Power Initiative (CCPI) 2nd solicitation**
- **The technology has been under development at the Power Systems Development Facility with sponsorship by DOE, Southern Company, EPRI, and others**

The FutureGen Project

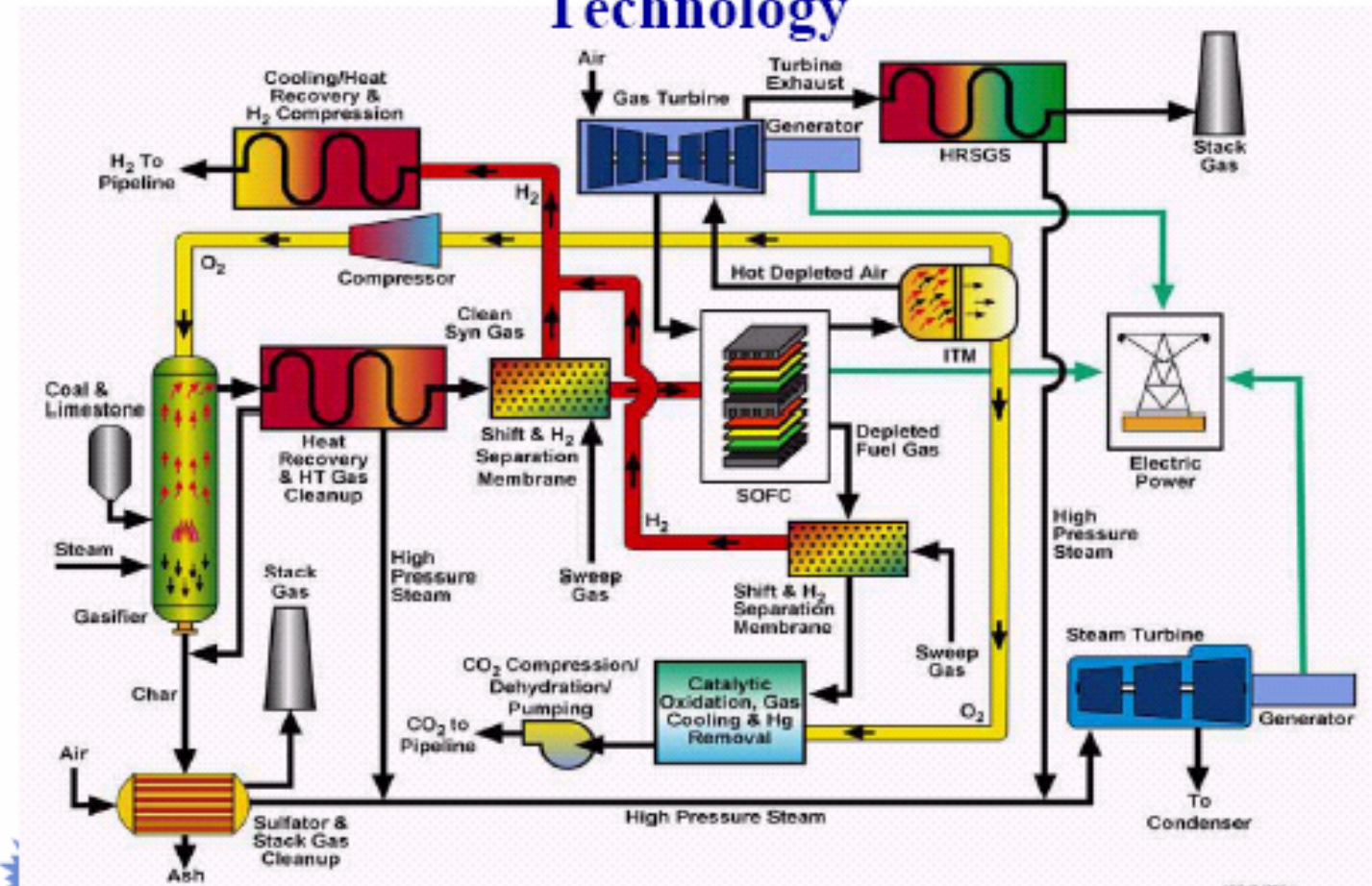
- **Integrated power (275 MW), hydrogen production (10 MM SCFD), and CO2 sequestration (1 million tons/year)**
- **Estimated operating period 2012-2015**
- **Estimated cost \$1 billion; ~80% DOE, ~20% FutureGen Alliance**
 - **(American Electric Power, PacifiCorp, Southern Company, TXU, CONSOL Energy Inc., Kennecott Energy, North American Coal Corporation, Peabody Energy, and RAG American Coal Holding**

IGCC with CO₂ Removal and Hydrogen Co-Production



Reference: EPRI

FutureGen Plant with Solid Oxide Technology



CO2 Capture in California

- **800 T/D of CO2 are captured by solvent scrubbing (Kerr-McGee technology) of coal boiler flue gas**
- **The plant has been in operation since 1978 at North American Chemical Company, in Trona, CA**
- **The CO2 is used for carbonation of brine to produce soda ash (sodium carbonate)**

Facts and Opinions for Discussion (1 of 4)

- As a result of current natural gas prices, hydrogen from coal will be now cheaper than hydrogen from natural gas, if both are produced in new plants. This is likely to be true for other chemicals as well**
- Coke, which is an excellent feedstock for gasification is exported from the Port of Los Angeles at low prices. It could be gasified at refineries in the LA area to make lower cost electricity than could be made from natural gas fueled gas turbines at current gas prices**
- The time for competitive coproduction of electricity, SNG, and chemicals from coke (certainly) and coal (possibly) may have finally arrived**

Facts and Opinions For Discussion (2 of 4)

- **CO₂ from the one US SNG plant is piped 200+ miles into Canada for Enhanced Oil Recovery (EOR)**
- **In many southwestern US locations, sequestered CO₂ from natural formations is extracted, pipelined hundreds of miles and used for EOR**
- **Injection of CO₂ from power plants into local saline aquifers will soon be validated across the country through DOE regional partnerships (including CA)**
- **Will there be a future market for coal-derived CO₂ in the US?**

Facts and Opinions to Ponder (3 of 4)

- **Very few (<10?) coal fired plants are now under construction in the US, although many are planned for the near future. Many (>100?) are under construction in China.**
- **No IGCC plants are under construction in the US or China. No coal gasification plants for chemical production are under construction in the US. Many such plants (>10) are under construction in China.**

Facts and Opinions to Ponder (4 of 4)

- **Construction of sophisticated gasification reactors (i.e., Shell) is much cheaper in Asia than elsewhere in the world. US fabricators no longer have the capability to produce these reactors.**
- **Imports of gasification reactors from Asia would markedly decrease IGCC plant capital costs.**

In Closing

- **Is it time to reconsider the use of solid fuels for power and chemical production to serve California's economic needs?**